Translated from German by
SCIENTIFIC TRANSLATION SERVICES
411 Wyntre Lea Dr.
Bryn Mawr, PA 19010

(19) European Patent Office (11) Publication No.: **0 587 085 A2**

(12) **EUROPEAN PATENT APPLICATION**

(21) Application No.: 93114256.6

(51) Int. Cl.^{5}: A61C 5/06

(22) Date of filing: 9/6/93

(30) Priority:
9/11/92 DE 9212249 U
1/21/93 DE 4302085

(43) Date of publication of patent application:
3/16/94 Patentblatt 94/11

(84) Designated contracting states:
AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL PT SE

(71) Applicant: Ihde, Dr. Stefan
Klaus Alfred
Lindenstrasse 68
CH-8738 Uetliburg (CH)

(72) Inventor: Ihde, Dr. Stefan
Klaus Alfred
Lindenstrasse 68
CH-8738 Uetliburg (CH)

(84) Agent: Weber, Wolfgang
Degussa AG
Fachbereich Patente
Rodenbacher Chaussee 4
Postfach 1345
D-63403 Hanau (DE)

(54) Process and Device for Metering and Blending Multicomponent Materials.

(57) The present invention pertains to a process and a device for metering and blending multicomponent materials, especially dental fillings based on dental cements, alloy and composites as well as their derivatives.

To prepare underfillings, fillings and cementings, which have different compositions, consistency and color, individually and rapidly by blending [German original incorrect - Tr.Ed.], a solution is proposed, which guarantees individual metering and intense blending of the material components, on the one hand, and, on the other hand, utilizes the advantages of a capsule blending and application system. The blend-specific data given on the code cards are fed into a computer for process control in a metering and blending device; the maximum allowable deviations from set limit values and the optimal blending time and blending force are determined on the basis of the preset values; the data thus obtained are

converted into control signals and used to fill a single-chamber blending capsule with the corresponding powdered and liquid material components from filled dispensers and for intensely blending the components after introducing the filled and closed blending capsule into a vibratory blender.

Figure 1

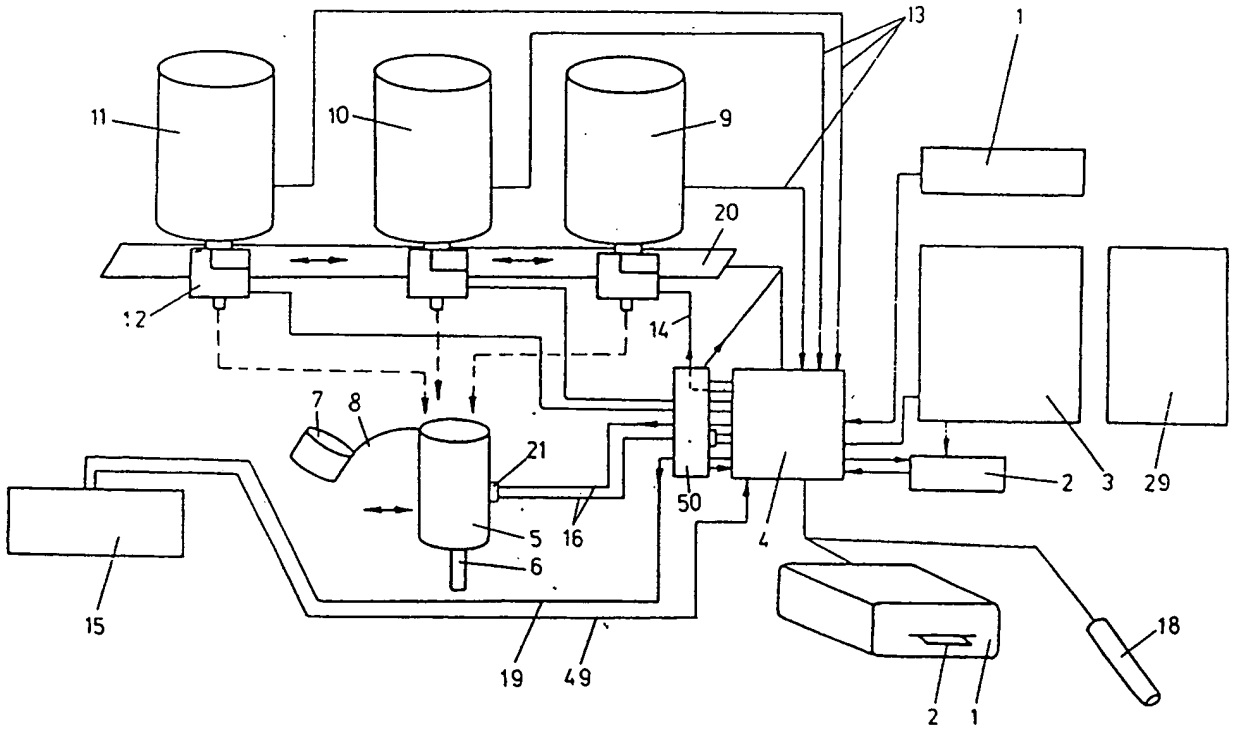

Fig.1

The present invention pertains to a process and a device for the quantitative, mutually independent, portion-by-portion metering and blending of multicomponent materials, which are composed of one or more powdered or liquid or pasty components, especially dental fillings based on dental cements, alloy and composites or their derivatives.

Dental cements are commercially available with the individual components premetered to the exact dosage, the powdered and liquid components being contained, premetered, in a blending capsule, but in separate compartments. After activation of the material components, which is performed according to the state of the art by rotating the parts of the capsule against each other; by applying pressure to a liquid cushion that is in contact with the blending chamber of the capsule laterally (DE Patent No. 23 24 296 C3) or in the rear (DE 39 20 531 A1, DE 37 18 326 A1), or by puncturing an internal liquid cushion with a mandrel arranged on the punch (DE 37 23 985 C2), the cushion is specifically opened, upon which the liquid component of the blend flows into the blending chamber. The capsule is subsequently subjected to intense vibration in a vibratory blender to intimately blend the components. To empty the contents of the capsule via a discharge opening, a punch arranged opposite the discharge opening is pushed forward into the inside of the capsule by means of a discharging device, after which the blend is emptied via the discharge nozzle. To do so, it is necessary to puncture the film bag, which contains the liquid component, more extensively (DE 37 23 985 C2), or a basket with the film bag must be pushed forward together with the punch. In the case of DE 23 24 296 C3, there are no obstacles between the punch, the blend and the discharge nozzle.

These prior-art blending capsules with discharge nozzles have the drawback that the liquid is always prepared from a multilayer material, wherein at least one layer consists of metal. The used capsules therefore form a difficult-to-dispose waste, which is composed of metal, plastic and filling components.

The blending ratio of the powdered and liquid components with one another is exactly set. This offers, on the one hand, the advantage that the components to be blended are present at the ratio preset by the manufacturer. On the other hand, the blending ratio cannot be changed by the user. This is disadvantageous because identical tooth-filling cements must frequently be blended in varying consistencies and different colors for different purposes, e.g., for underfillings, fillings or cementing. However, this is not possible in the case of the prior-art capsules, in which the manufacturer has preset the ratio of the components to be blended to one another.

It is also necessary, in particular, to keep a considerable amount of capsules in stock in order to keep ready blending materials of different types and colors and with different blend contents for tooth cavities of different sizes and for different applications.

Furthermore, the prior-art capsules can be used only once. Consequently, it is not possible to take the capsules apart into the individual components after blending and to reuse the components after cleaning, because, in particular, the film cushion with the liquid component was destroyed.

The prior-art blending capsules with discharge nozzles for cements must be activated in order to bring the components to be blended accommodated in separate compartments in connection with one another. Moreover, they are expensive due to the preparation and filling mechanism comprising many steps.

At any rate, the prior-art blending capsules also offer the advantage that the blended composition can be directly introduced into the tooth cavity via the discharge nozzle or it can be applied to the workpiece to be cemented. The blending capsules are handy and, because they are used for one patient only, also always sufficiently clean.

Mechanically driven blending and metering mechanisms for the blend components of dental fillings have also been known (DE 1 288 739, DE 1 101 692), which make possible the mechanical metering and blending of dental materials. However, these devices were designed, in principle, for the use of amalgam.

Its metering is unproblematic because of the high specific gravity of mercury and the correspondingly good flowability as well as due to the flowability of the alloy filings. In addition, the blending ratio of alloy and mercury always remains relatively constant. However, these conditions do not apply to the preparation of dental fillings based on dental cements. The prior-art devices also have no control for an automatic metering and blending of the material components, because they were developed only for two material components, whose blending ratio varies only slightly. Therefore, these solutions cannot be used for blending dental fillings from multicomponent materials that are different from one another.

DE 1 566 287 and DE 2 322 681 propose a metering and blending device for preparing dental fillings from mercury and amalgam, in which the components of the blend are compounded by means of a metering roller, which has separate chambers. The metered partial amounts are subsequently introduced via a funnel into a blending tube and then into a blending capsule. To avoid errors in operation, the blending and metering device can be switched on only when a blending capsule has been attached.

This metering and blending device likewise cannot be used to blend a dental filling consisting of a plurality of components based on dental cements, as they are needed for preparing underfillings, fillings and cementings. On the one hand, the metering roller present does not allow the metering of multicomponent materials. On the other hand, the poorly flowable dental cements would not run through the relatively long path from the inlet funnel via the blending tube into the blending capsule. The entire gravity section would become contaminated and clogged in a short time due to the high degree of stickiness of the cements. To accurately maintain the blending ratio of the material components to be blended along with a high reliability of operation and to guarantee the cleanliness required in dentistry, the device proposed would have to be cleaned thoroughly after each blending process.

A device for automatically measuring and metering liquids, especially for paints, has been known from German Offenlegungsschrift No. 2 944 869. This device is preferably used to prepare paint blends from different basic paints, which are stored and kept ready in separate containers. The control and monitoring of the process and operations is performed via a computer. Monitoring of the device and of the filling processes is also possible by a visual display of the data on a display at the same time. The individual blending characteristics of the paint blends can be stored in the computer and polled for a possible later reproduction of the paint composition.

To increase the productivity of metering and blending processes and to relieve the operating personnel at the same time, German Offenlegungsschrift No. DE-OS 3 102 611 and German Offenlegungsschrift No. DE-OS 2 431 974 disclose process controls that have an input device, an order data memory and a process computer, including a process control connected to the computer. The latter solutions pertain without exception to industrial plants, in which substantially greater tolerances are inherently permissible in the blend compositions. These proposed solutions cannot therefore be applied and extrapolated to the highly accurate metering of a relatively small amount of a composition consisting of a plurality of components, which are required in dentistry.

The basic object of the present invention is to propose a solution of this class as mentioned in the introduction, which makes possible an error-free, rapid and uncomplicated blending of dental filling materials of various compositions and consistencies based on dental cements for preparing underfillings, fillings and cementings.

This object is accomplished according to the present invention by entering the doses of mutually different material components, which doses are intended for the filling composition to be blended with the characteristics of the blending process following the metering, via a data storage medium or as a code, and the amount of material needed and the consistency as well as the color of the blended composition into a computer for controlling a blending and metering device for dental filling materials via a keyboard; by comparing the metered amounts of the individual material components with data stored in the computer for a maximum allowable deviation in consistency, and by converting the data

thus calculated into a signal for controlling means for metering and feeding the powdered and liquid components to be blended into a blending capsule. The powdered and liquid material components determined by the dental filling composition to be blended are introduced, accurately metered by means of a metering means, into a single-chamber blending capsule, which is introduced into a blender, preferably a vibratory blender, after being closed by a punch connected to the capsule body, in order to intensely blend the material components with one another based on the blending characteristics entered.

The blending characteristics stored in a data storage medium, e.g., a magnetic strip card or a chip card, may contain the necessary information and instructions for combining different powdered components with one another and/or the possible metering ratio of one or more powdered material components to one or more liquids.

Together with the blending characteristics recorded in the data storage medium, operation-specific characteristics of the blending device can be entered according to another feature of the present invention, the best possible blending time can be calculated by the computer from the preset values for the dental filling composition to be blended and the characteristics of the material components entered, and this blending time can be sent to a blender via a control line.

To further simplify or facilitate the manual activities during the blending of dental filling compositions, it is advantageous to enter the needed amount of the filling composition and its consistency together with the characteristics for the metering and blending of the material components via a data storage medium.

Furthermore, the specific blender characteristics of the types of blenders used most frequently can be stored in the memory and be polled at the beginning of the metering and blending process via the keyboard.

Another possibility of variation is to feed these blender characteristics into the process computer manually via the keyboard. Besides the above-mentioned magnetic strip cards and chip cards, the desired process data may also be read into the process computer via bar codes.

The device according to the present invention for metering and blending multicomponent materials has a computer-aided process control, wherein a data entry station for the blending characteristics stored in the data storage medium, a memory for the limit values of the components to be blended, which are not to be exceeded, and an input keyboard are connected to the input of the computer, besides the filling level signal lines of the individual dispensers, in which the powdered and liquid material components are kept ready, and the signal line for the readiness of the blender to operate. The output of the computer is connected via a process control unit to the process control for the means for metering the components to be blended and to the control input of the vibratory blender.

The characteristics fed into the computer via the data storage medium for metering and compounding the material components to be blended are used, according to another solution variant proposed according to the present invention, for controlling a slide bar, which is provided with a metering opening, via which the powdered and liquid material components are introduced into the blending chamber of a single-chamber blending capsule. To do so, the single-chamber blending capsule, clamped in a holder, is positioned under the holder of the corresponding dispenser. The slide bar is advantageously provided with a cam, which induces vibrations in cooperation with a fluting in the bottom part of the holder of the dispenser when the emptying position of the slide bar is reached and guarantees as a result that the amount of material present in the metering opening will be completely dispensed into the blending chamber of the single-chamber blending capsule and material bridges within the dispenser, which make the trouble-free discharge of the material being stored difficult, are prevented from forming.

The storage container for the individual material components, which are preferably also used as dispensers at the same time, are provided in the area of

the side located opposite the blending capsule opening with a discharge slot of variable opening width, via which the material components being stored are metered. To support the metering process, the storage container is additionally set to vibrate during the discharge of the materials, as a result of which even poorly flowable liquid and powdered material components can be discharged and metered reliably and accurately.

The control signals generated by the process computer based on the blending characteristics stored in the data storage medium can be used, according to another embodiment variant of the device according to the present invention, to control an adjustably and movably arranged pipette, which is connected to a reciprocating pump in order to remove the material components to be blended from the dispensers in a metered manner and to introduce them into the blending chamber of the single-chamber blending capsule.

The single-chamber blending capsule is provided with a circular groove in the area of its front-side filling opening and is clamped by means of this groove in a holder, which may be arranged either stationarily or displaceably. The blending chamber of the single-chamber blending capsule, which has been known to be used to directly introduce the blended filling material into the cavity via a discharge nozzle, is closed by a separating membrane from the discharge opening of the discharge nozzle. This separating membrane is punctured by means of a mandrel provided on the punch during the squeezing out of the filling material and the blended material is discharged while the punch is pushed farther forward. However, the discharge opening of the discharge nozzle may also be closed by means of an extractable mandrel, which is pushed forward during the squeezing out of the blended material and is then removed by hand.

The capsule body of the single-chamber blending capsule is advantageously provided with grip parts, which facilitate handling during the discharge of the blended material.

According to another feature of the single-chamber blending capsule proposed, the punch is provided with sealing lips, which additionally fix the punch inserted after blending in the material components to close the capsule in cooperation with the groove arranged in the capsule and reliably prevent the blended filling composition from escaping into the rear space behind the punch during the discharge from the blending capsule.

In a preferred embodiment of the device according to the present invention, a protocol of the control and metering processes is prepared and printed out by means of a connected printer. On the other hand, it is also possible to pass on the metering data via a data line to the normal practical computer, in which they are attached to the patient data and are thus available for therapy monitoring at any time. Rather large patient groups and a large number of filling and cementing procedures can thus be documented in a computerized manner and be easily evaluated statistically.

Using the solution proposed, dental filling materials based on dental cements can be prepared in any desired composition and with different consistencies and colors depending on the intended use in a simple manner at the best possible blending ratios from different material components, and the operator is relieved of additional operations for data input and compiling the necessary blending-specific data. Individual errors in the preparation of the dental fillings are thus ruled out completely and high quality is ensured. Using the solution proposed, the individual material components are metered separately and accurately, introduced into a single-chamber blending capsule of simple design, which can be reused after corresponding cleaning, and the components are intensely blended with one another based on accurately determined blending data. To exactly check the metering process, the filling in of the material to be blended is checked gravimetrically, the weight determined is fed into the computer to check whether the metering process takes place properly, and the weight determined influences the control unit.

Since the human eye may make errors in evaluating colors, especially under different lighting conditions, and, in particular, the lightness, the tone and the saturation of the color of the surface of an object are difficult to evaluate objectively, colorimetric systems were developed, which measure these

properties of color in an absolutely objective manner and indicate them as space coordinates. It has not been hitherto possible to adequately use the results obtained for selecting plastic filling materials, because there was no possibility of preparing a filling blend that corresponds to the measured result by hand in the short time available. This is now possible, for the first time ever, by means of the process according to the present invention and the device according to the present invention. Thus, the measured values obtained for the lightness, tone and saturation of the color of a tooth or, e.g., of the opposite, nondestroyed tooth or of an adjoining dental restoration can be measured objectively by means of a color-measuring probe, e.g., in the LAB system, accurately converted in the process computer and directly converted into signals for controlling the metering device.

The process computer can even take into account material-related deviations in terms of the saturation of the color (taking into the account the known opacity of the filling material available, which is to be metered), and to adjust the values obtained for lightness and tone. This computerized procedure cannot be implemented in the case of manual blending and according to the state of the art known hitherto.

It is a known phenomenon, especially in the case of cement-based dental materials, that an excessively "light" filling is obtained due to the high opacity of the material despite the "correct" selection of the color. This effect can be reduced by computerized color matching to the extent that no or hardly any lightening is visible any longer on a visual inspection of the finished filling.

In another embodiment, even a plurality of layers of filling blends to be applied one after the other can be determined by the process computer and be suggested to the operator, taking into account the data entered for the color and using the colorimetric results. It is thus possible to prepare fillings that come very close to the true appearance of the tooth.

The present invention will be explained in greater detail below on the basis of an exemplary embodiment. In the drawings belonging to the specification,

Figure 1 shows a schematic view of the device for metering and blending multicomponent materials,

Figure 2 shows an exemplary arrangement of a dispenser for providing a powdered material component,

Figure 3 shows a schematic view of an arrangement for introducing metered material components into a blending capsule by pipetting,

Figure 4 shows a preferred embodiment of the single-chamber blending capsule, and

Figure 5 shows the block diagram of the metering and blending device according to the present invention.

The device for metering and blending multicomponent materials, which is schematically shown in Figure 1, has a plurality of dispensers 9; 10; 11, in which both the powdered material components based on dental cement and alloy, which have different colors and compositions, and the liquid material components are stored and kept ready. The individual dispensers 9; 10; 11 are inserted into a holder 12, e.g., by means of a threaded connection 52 (Figure 2) and connected to the input of a computer 4 via signal lines 13 for displaying the filling level. In a first embodiment of the present invention, the dispensers 9; 10; 11 with the holders 12 are arranged stationarily, while the single-chamber blending capsule 5, which is inserted into a holder 21, is moved in the known manner, not shown, to the corresponding dispensers 9 through 11 for receiving the metered powdered and liquid components to be blended, depending on the dental filling composition to be blended. As an alternative to this, the single-chamber blending capsule 5 with its holder 21 may also be arranged stationarily, i.e., in a fixed position, while the corresponding dispensers 9; 10; 11 are moved over the stationarily arranged single-chamber blending capsule 5, e.g., by means of a turntable arrangement, in agreement with the blending characteristics entered, and the desired material components are introduced into the blending chamber.

Besides the filling level signal lines 13, a data storage medium entry station 1 for the blending characteristics stored on code cards, e.g., magnetic strip cards or chip cards, a memory 2 for storing constant data for the metering and blending process, a keyboard 3 for individual data input, and the signal line 19, which sends the signal on the readiness of a blender, e.g., a vibratory blender 15, to operate to the computer 4, are also connected to the input of the process computer 4. To expand the entry of the blending and metering data, a bar code reader 18 is additionally provided, besides the data entry station 2 for the code cards.

The blending-specific characteristics for preparing an underfilling, a filling or for cementing cavities, which characteristics differ in terms of the material composition, consistency and color, are stored on a code card and they are fed into the computer 4 via the data entry station 2. The best possible blending time and blending force are determined in the computer 4 from these preset values, the data stored in the memory 4 [sic - Tr.Ed.], e.g., the performance data of the connected vibratory blender 15 and, e.g., the quantity data for the needed filling composition, which are entered via the keyboard 3. At the same time, these data are compared with the maximum allowable limit values for the composition of the material components to be blended, which are stored in the memory 2. The data entered are optically displayed once again by the display 17 connected to the computer and they may be optionally corrected or supplemented.

The specific data determined by the computer 4 for every individual filling composition to be blended on the basis of the preset values are converted into control signals and are sent to the metering devices of the dispensers 9; 10; 11, to the means for positioning the single-chamber blending capsule 5 and to the vibratory blender 15 via the process control 50 and the control lines 14; 16; 19. After filling the metered powdered and liquid material components into the single-chamber blending capsule 5, the said capsule is closed by the punch 7, which is articulated to the capsule body via the flexible connection 8, and the capsule is introduced into the mounting fork of the vibratory blender 15 for intensely blending the material components.

To guarantee individual metering and at the same time to utilize the advantages of a capsule blending and application system, a blending capsule 5 with a completely open front side 53, which can be closed by a punch 7, and with a discharge nozzle 6 arranged on the opposite side is used (Figure 4). The blending capsule 5 comprises only a single blending chamber 41 and contains no additional compartments. The blending chamber 41 of the blending capsule 5 is optionally closed against the opening 48 of the discharge nozzle 6 by a separating member 46. Components of the blend are thus prevented from settling in the opening 48 during the metering and/or blending process and thus from escaping the blending process. When the punch 7 inserted into the blending chamber is pushed forward, the separating membrane 41 is punctured by means of the mandrel 40 located on the punch and the blended filling composition located in the blending chamber 41 is discharged from the capsule via the opening 48 of the discharge nozzle 6 and is introduced into the cavity to be filled. In an alternative embodiment, the opening 48 is closed by a pin-like insert 45, which is introduced into the opening 48 in a sufficiently firmly seated manner in order to prevent it from loosening spontaneously. To discharge the blended filling composition, the insert 45 is first pushed forward to the extent that it can be pulled out by hand. An unhindered discharge of the filling composition is then guaranteed. The punch 7, which can be introduced into the blending capsule, is also provided with sealing lips 54, which engage an inner radial groove 55 upon introduction of the punch 7 into the capsule 5 and additionally fix the punch 7 against a possible sliding out from the capsule 5. At the same time, the sealing lips 54 prevent the blended material from being emptied into the rear part of the blending capsule 5 along the punch 7 being pushed forward, instead of being squeezed out via the discharge nozzle 6. An outer groove 43, which is limited by contact slopes 42 and is engaged by the pins 27 of the holding arms 22 of a holder 21 for positioning the single-chamber blending capsule 5 during the metering process, is provided on the outer jacket of the blending capsule. The groove 21 is also used to attach a discharging device, by means of which the inserted punch 7 is pushed forward and the discharge of the blended filling composition is facilitated. A grip member 47 for easier

handling of the blending capsule 5 according to the present invention is advantageously provided beneath the groove 43 limited by contact slopes 42.

Both the design and the manufacture of the single-chamber blending capsule 5 according to the present invention are substantially simpler and less expensive compared with the prior-art capsules with discharge nozzles. Separating layers for forming compartments within the capsule are completely unnecessary. In addition, the introduction of film cushions can be eliminated. After the blended filling composition has been completely discharged, the blending capsule is cleaned and it can be reused after the individual parts of the capsule are assembled. If the single-chamber blending capsule 5 will not be reused, it can be disposed of in a simple manner.

As is apparent from Figure 2, the dispenser 9 for storing a powdered material component is inserted by means of a threaded connection 52 into a holder 12, which may be arranged either stationarily or movably. On the bottom side, the holder 12 has a discharge 28 with a discharge hole, which communicates with a metering opening 25 in a movable slide bar 20. A holder 21, in the holding arms 22 of which the single-chamber blending capsule 5 to be filled is clamped in a positive-locking manner, is located under the slide bar 20. The holder 21 has an inlet tube 29, via which the amount of material being metered by means of the metering opening 25 in the slide bar 20 is emptied into the single-chamber blending capsule 5. As was described above, the holder 21 may be arranged movably in the case of stationarily positioned dispensers 9; 10; 11 and stationarily in the case of movably arranged dispensers. A spring 23, which presses the slide bar 20 against the bottom-side part of the holder 12, is provided in a recess of the holder 21. Furthermore, the slide bar 20 is provided at one end with a cam 24, which cooperates with a fluting 26 in the bottom part of the holder 12 and induces vibrations when the emptying position of the slide bar 20 has been reached in order to guarantee complete emptying of the powdered material present in the metering opening 25. It has been found that cohesive cement powder readily sticks in the metering hole 25 without mechanical effects and it may cause disturbances in the metering process as a result. In addition, the vibrations induced by the cooperation between the cam 24 and the fluting 26 prevent the formation of material bridges within the dispenser 9, which could prevent a trouble-free feed of material into the freed opening 28. The slide bar 20 for emptying the material located in the metering hole 25 is adjusted and is returned into the starting position by means of prior-art means via the process control 50 based on the data entered and calculated by the computer 4.

Another possibility of filling a single-chamber blending capsule 5 individually with an exactly metered amount of material is shown in Figure 3, where the material components are removed and filled into the single-chamber blending capsule 5 by means of a pipette arrangement. The pipette 34 used to meter and feed the powdered and liquid material components is clamped in a holder 36 and is movable in a vertical plane and a horizontal plane alike along a rail 35. The material components to be taken up according to the data entered are metered by means of a reciprocating pump 37, which is connected to the process control 50 via control lines 38 and to which the pipette 34 is connected via a flexible connection 39. The powdered and liquid material components are again stored in dispensers 30, 31 and 32, into which the pipette 34 is introduced to take up the desired amounts of material, the desired material component is taken up in a metered manner by means of the reciprocating pump and is introduced into the blending chamber 41 via the single-chamber blending capsule 5, which is open on its front side 53, after displacing the pipette. The movement of the pipette is again controlled by the process control unit 50 controlled by the computer 4.

Dispensers with flexible walls, which are provided with a slot at their lowermost point, are suitable, in particular, for metering powders; the said slot is widened and closed mechanically to varying extents and the component to be blended is set into motion at the same time by rhythmically knocking the outside of the metering device. As a result, it is possible to meter very accurately even cohesive powders.

A metering process will be explained as an example below:
Given is a metering device according to the present invention with at least five

storage and metering places for powdered material components for two storage and metering places for liquid and/or pasty material components.

The preparation of a filling composition of color A in an amount I with a medium consistency is required.

The color A is composed, as is entered into the memory, of the powder components 1 (30%), 2 (10%), 3 (50%), 4 (8%), and 5 (2%). The preset values for the metering of powder and liquid are as follows:

Consistency:	Liquid	Medium	Solid
	Metering ratios (weight percent) (powder:liquid)		
Component 1	1:5.5	1:4.3	1:2.3
Component 2	1:5.5	1:4.3	1:2.3
Component 3	1:4.8	1:3.9	1:2.0
Component 4	1:2.9	1:2.1	1:1.1
Component 5	1:5.5	1:4.3	1:2.3

Components 1 through 3 are always blended with liquid 1; components 4 and 5 are always blended with liquid 2. Liquid 1 and liquid 2 may be blended with one another in a blending capsule. There is compatibility between all the liquids and powders used. This circumstance is recognizable for the computer from the characteristics of the blend in combination with the stored data.

Via the filling level signal lines, the computer has information on the sufficient filling of the storage places in question and their storage tanks. This information may also be obtained via the previous removal of materials since the latest refilling.

The metering ratios for the particular component were fed into the computer and stored together with the color variant and the storage place in the metering device at the time of the filling up of the device.

The following quantities are specified (they are entered, e.g., into the memory of the computer):

I 400 mg of powder, plus the corresponding amount of liquid,
II 600 mg of powder, plus liquid,
III 800 mg of powder, plus liquid.

The metering process takes place as follows, the order of the powder components being irrelevant:

Component 1: 120 mg
Component 2: 40 mg
Component 3: 200 mg
Component 4: 32 mg
Component 5: 8 mg.

The filling of the blending capsule is always checked for the individual filling component.

The following filling is calculated from the "medium" consistency specified and the metering ratios:

Liquid 1	120 mg x 4.3
	40 mg x 4.3
	200 mg x 3.9
Mean ratio:	1:4.077
Amount of powder to be considered:	360 mg
Amount of liquid (1) to be introduced:	1467.99 mg
Liquid 2	32 mg x 2.1
	8 mg x 4.3
Mean ratio:	1:4.064
Amount of powder to be considered:	40 mg
Amount of liquid (2) to be introduced:	162.56 mg
Total amount of filling:	2030.55 mg

Calculation of blending time:

An optimal blending time of 10 sec is assumed for liquid 1. The corresponding blending time is 6 sec for liquid 2. Since a substantial part of the blending time is needed for dissolution processes, which take place prior to the thorough blending, the longest blending time of an individual component is always preset as the blending time. The blending time is consequently 10 sec in this case. In the case of separate blending, this information is displayed to the operator on the display. Integrated blenders are controlled correspondingly.

Patent Claims

1. Process for metering and blending multicomponent materials, especially dental filling materials, based on dental cements and composites, and for metering dental materials, especially ceramic powders and veneer materials, using a data storage medium or codes for entering predetermined data for controlling a metering and blending process of material components to be filled into single-chamber blending capsules,
characterized in that
the metering characteristics of the material components, which determine the filling composition to be blended and also include information on the maximum allowable quantity ratios and on the possible metering ratios, are fed into a computer for controlling a device for metering and blending dental filling materials via a keyboard or bar codes, together with the blending characteristics for the subsequent blending process, at the time of the filling up of the storage places with material to be blended, via a data storage medium or a code and the amount of the composition to be blended and the preset values on the type of the composition to be blended, including its consistency; the amounts of the material components to be metered are calculated from the stored data and the above-mentioned preset values are converted into a signal for controlling means for metering and feeding the powdered and liquid or pasty components to be blended into a blending container or into a blending capsule, and, in the case of the blending capsule, the materials contained in the blending capsule or in the blending container are blended with one another after closing the blending capsule on the basis of the calculated or entered blending characteristics.

2. Process in accordance with claim 1,
characterized in that
the color data of the composition to be blended are entered via letter and numeric codes, wherein the computer calculates the necessary metering ratio of the different components to be blended as a function of the desired quantity of the composition to be blended and the desired consistency by evaluating the data on the filling up of the storage places for the powdered, liquid or pasty components, and converts it into signals for controlling metering means.

3. Process in accordance with claims 1 and 2,
characterized in that
together with the data for the metering of the material components, the needed filling composition and its consistency are entered via a data storage medium, which optionally also contains the data on the blending time and the blending frequency.

4. Process in accordance with claims 1 through 3,
characterized in that
the specific metering characteristics (for the filling materials from different manufacturers), including the blending ratios of powder and liquid and the data on the compatibility of filling materials of various types, coloration and manufacturers, are preset in a data storage medium and are polled by the computer for controlling a metering device.

5. Process in accordance with claims 1 through 4,
characterized in that
the metering of the components to be blended is monitored gravimetrically, wherein the weight percentage of every individual component to be blended

is measured during metering and the ratio of powder and liquid components to one another is calculated from the amount of the powdered components and their respective powder-to-liquid coefficients, taking into account the material-specific metering characteristics and the desired consistency of the blend entered, and the result of the weighing obtained for the amount of the material to be blended, which has already been filled in, is entered into the computer.

6. Process in accordance with claim 5, **characterized in that** the metering of the components is performed volumetrically.

7. Process in accordance with one of the claims 1 through 5, **characterized in that** a report is prepared on the metering performed, and the report is optionally printed out or is sent to a separate practical computer by data transmission, wherein the data on the metering and blending ratios and on the batches used are attached to the patient data.

8. Process in accordance with one of the claims 1 through 7, **characterized in that** the data on the color specification of the composition to be blended are determined via an electronic colorimetric system connected to the device via a data line and are directly converted into signals for controlling metering means in the process computer.

9. Process in accordance with claim 8, **characterized in that** the color values measured according to a colorimetric system are fed into the process computer via the keyboard, wherein the color information is defined as values of lightness and/or tone and/or saturation of the color.

10. Process in accordance with claims 8 and 9, **characterized in that** to reproduce the measured color values, a plurality of layers of individual filling blends with different lightnesses, tones and color saturations, which are to be applied one after the other, are calculated by the computer and suggested to the user.

11. Device for carrying out the process in accordance with claims 1 through 10, comprising dispensers for storing and dispensing powdered and liquid or pasty material components, and also comprising metering devices for the quantitative, mutually independent, portion-by-portion metering of the desired blend components, which are actuated by a computer-aided control, and also comprising an integrated or separate vibratory blender, which intensely blends the material components introduced into a blending capsule having a discharge opening and a displaceable punch, **characterized in that** besides the filling level signal lines of the dispensers (9, 10, 11) and the readiness-to-operate signal line (19) of a blender (15), a data input station (1) for the blend-specific data to be entered on data storage media or via codes, a memory (2) for the limit values of the blend components, which are not to be exceeded, as well as for supplying the blend-specific calculated data, as well as an input keyboard (3) and the signal output of a control scale are connected to the input of the computer (4) of the process control unit, and the computer output is connected to the process control (50) for the means for metering the blend components and for controlling the blender (15), wherein all blend components of the desired filling composition are introduced into the blending chamber (41) of a single-chamber blending capsule (5) from the storage container via an open front side (53), and the single-chamber blending capsule (5) can be closed after the metered filling-in of the blend components by a punch (7), which can be pushed forward and is used at the same time as the pushing punch for emptying the capsule.

12. Device in accordance with claim 11, **characterized in that**

the blend-specific data needed for preparing the filling composition are stored on magnetic strip cards or chip cards.

13. Device in accordance with claim 11,
characterized in that
the blend-specific data are read into the memory (2) in the form of numeric codes in agreement with the filling up of the storage places (9-11).

14. Device in accordance with claim 11,
characterized in that
the data needed for preparing the filling composition are entered via a bar code reader.

15. Device in accordance with one of the claims 11 and 14,
characterized in that
the liquid material components are introduced into the blending chamber (41) of a single-chamber blending capsule (5) in a metered manner by means of a pipette (34), which are [sic - is - Tr.Ed.] connected to reciprocating pumps or metering syringes.

16. Device in accordance with claim 11,
characterized in that
the means for metering the material components to be blended comprise a slide bar (20), which is provided with metering openings (25) and is provided with a cam (24), which induces vibrations in cooperation with a fluting (26) [on - Tr.Ed.] a holder (12) when the emptying position of the bar is reached.

17. Device in accordance with one of the claims 11 through 16,
characterized in that
the storage containers used as dispensers (9, 10, 11) have a discharge slot with controllable opening width and can be set into vibration during the discharge.

18. Device in accordance with claims 11 and 16,
characterized in that
the slide bar (20) is mounted displaceably in a holder (12) of the dispensers (9, 10, 11), and the single-chamber blending capsule (5) is positioned under an inlet tube (29) between holding arms (22) of a holder (21).

19. Device in accordance with claim 11,
characterized in that
the blending chamber (41) of the single-chamber blending capsule (5) is closed against the discharge nozzle (6) by a separating membrane (46), which is punctured during the discharge process by a mandrel (40) arranged on the punch (7), and the punch (7) is articulated to the blending capsule (5) by a flexible connection (8).

20. Device in accordance with claims 11 and 18,
characterized in that
the single-chamber blending capsule has a circular groove (43) or gripping elements (47) in the area of its open front side.

21. Device in accordance with claims 11, 18 and 19,
characterized in that
the opening (48) of the discharge nozzle (6) is closed by a pin-like insert (45).

22. Device in accordance with claims 11 and 18 through 20,
characterized in that
the punch (7) is provided with a sealing lip (54), which cooperates with a radial groove (55) in the single-chamber blending capsule (5).

Figure 1

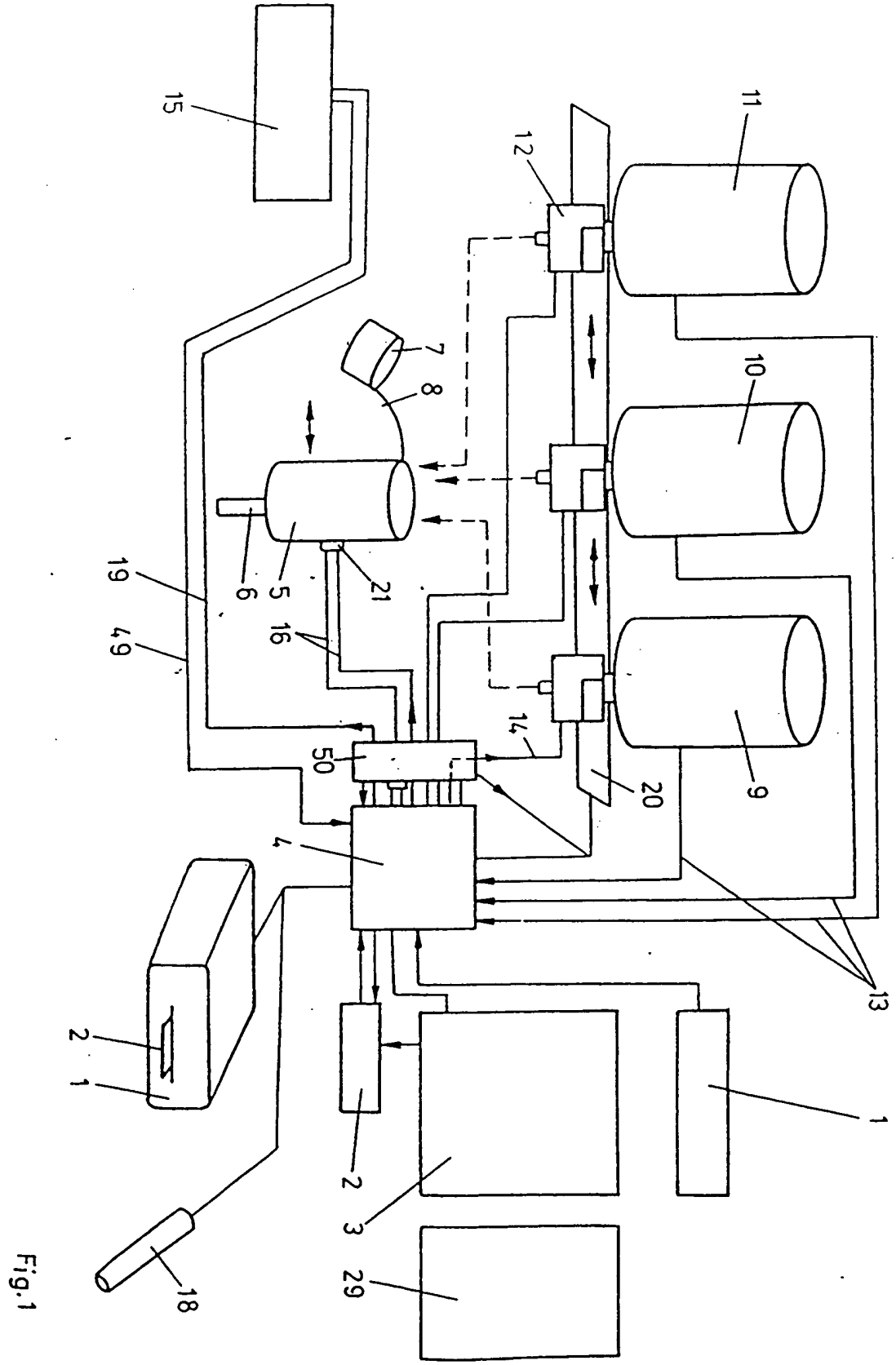

Fig.1

Figure 2

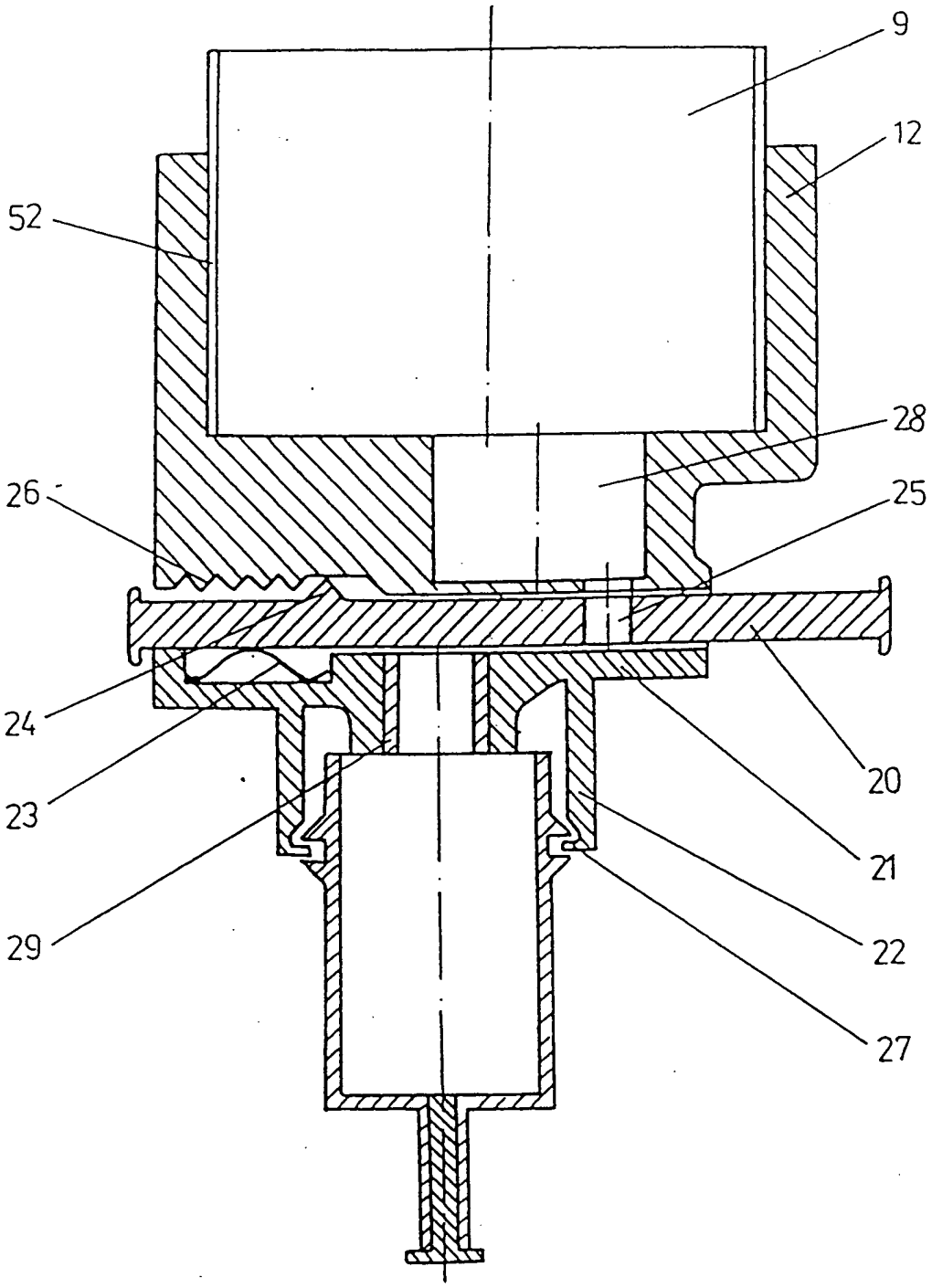

Fig. 2

Figure 3

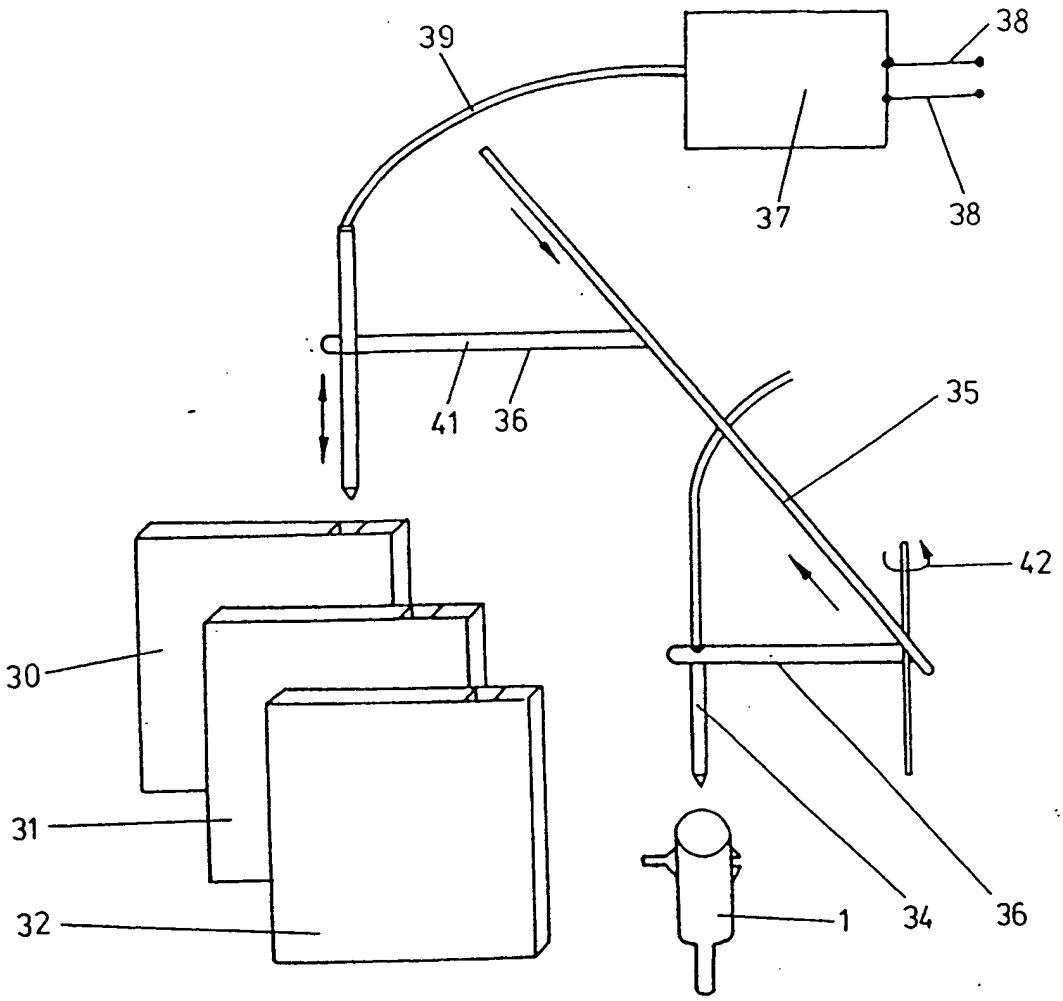

Fig. 3

Figure 4

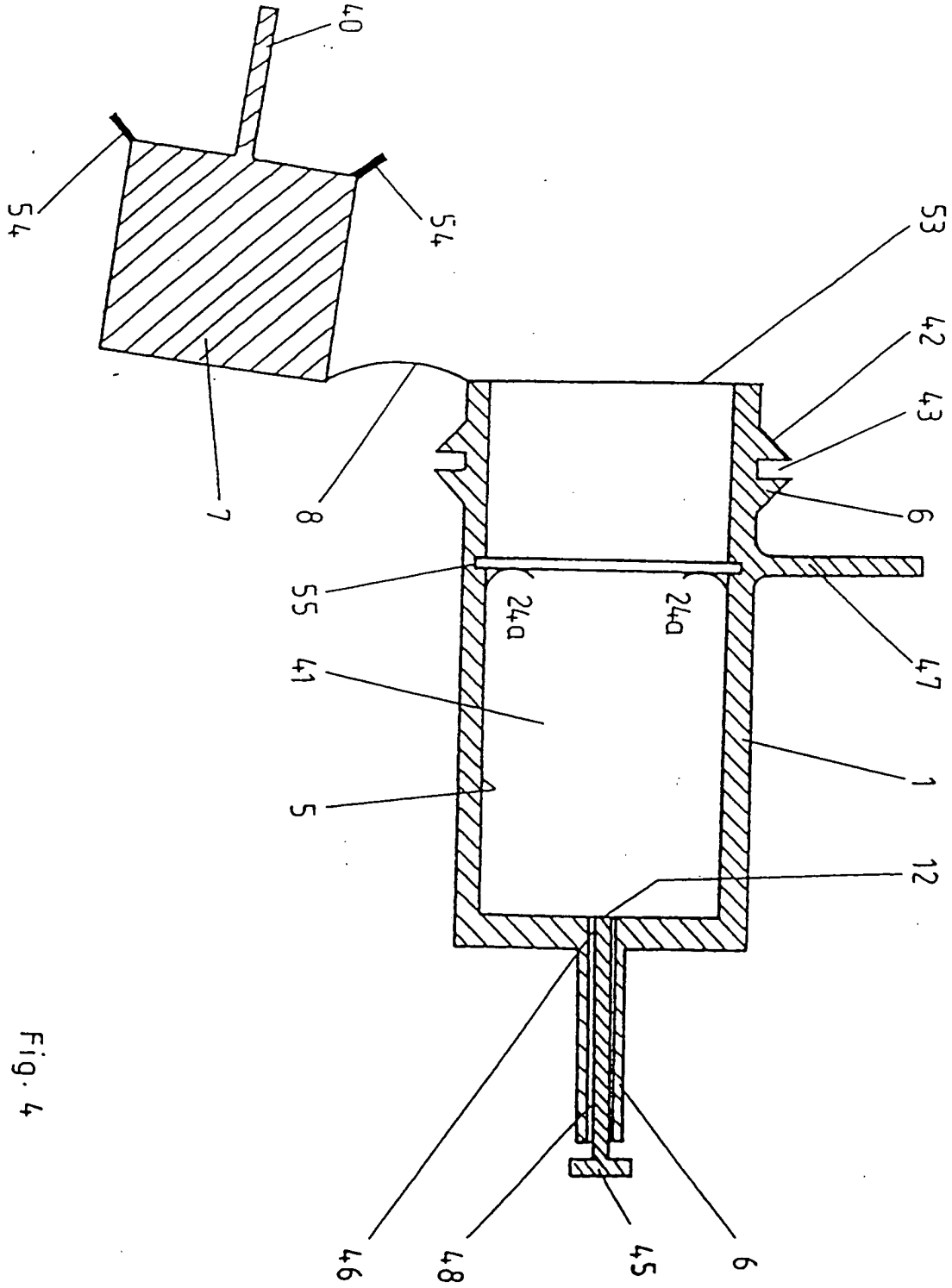

Fig. 4

Figure 5
KEY:
Dosierer/Pipette/Verschieberiegel = Metering device/pipette/slide bar
Einraum-Mischkapsel = Single-chamber blending capsule
Waage = Scale
Mischer = Blender
Kapsel = Capsule
Prozeßsteuerung = Process control
Rechner = Computer
Tastatur = Keyboard
Dateneingabe = Data entry
Barcodeleser = Bar code reader

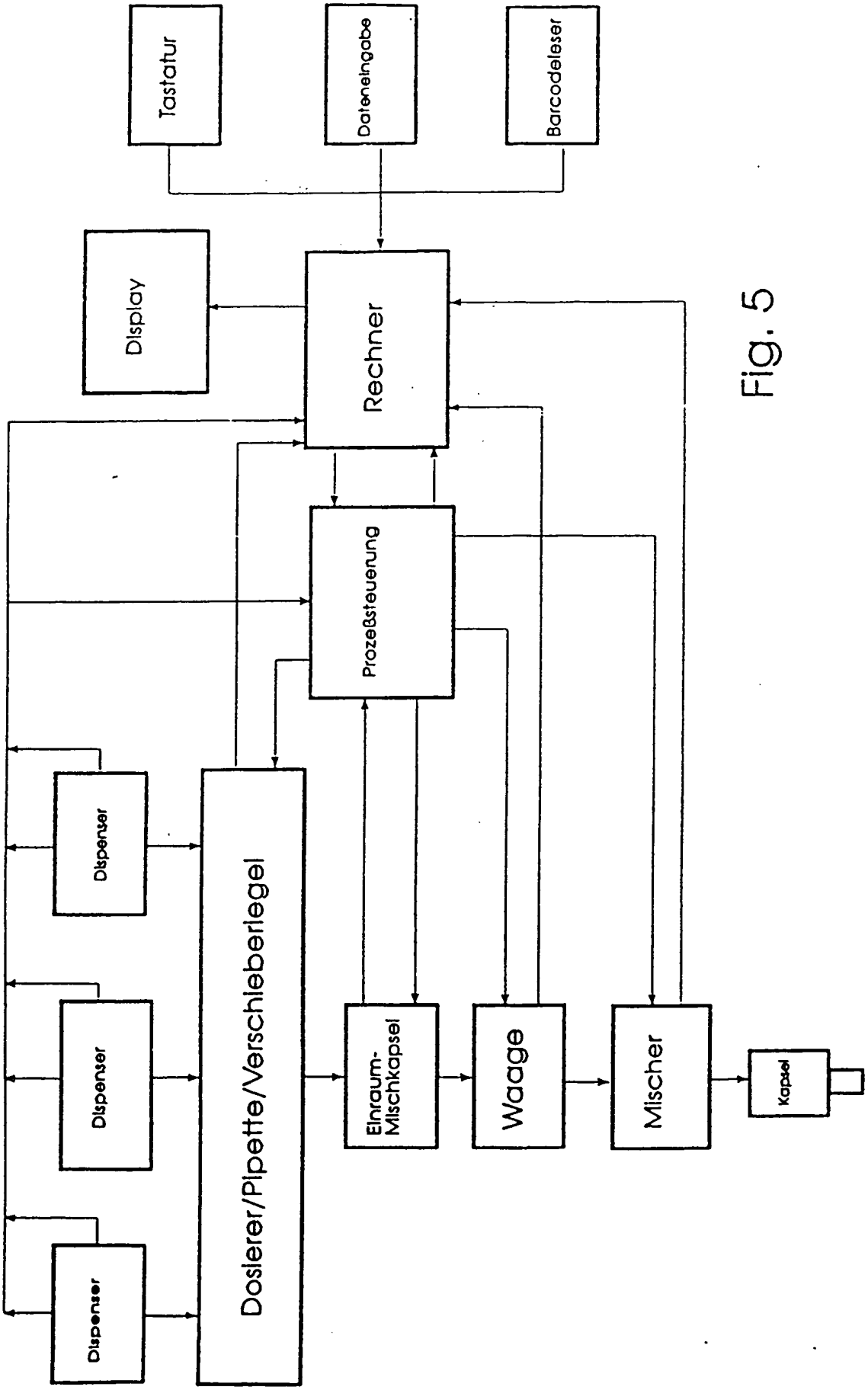
Tastatur
Dateneingabe
Barcodeleser
Display
Rechner
Prozeßsteuerung
Dispenser
Dispenser
Dispenser
Dosierer/Pipette/Verschieberlegel
Einraum-Mischkapsel
Waage
Mischer
Kapsel

Fig. 5

(19) European Patent Office (11) Publication No.: **0 587 085 A3**

(12) **EUROPEAN PATENT APPLICATION**

(21) Application No.: 93114256.6

(51) Int. Cl.^{5}: A61C 5/06, B01F 13/00

(22) Date of filing: 9/6/93

(30) Priority:
9/11/92 DE 9212249 U
1/21/93 DE 4302085

(43) Date of publication of patent application:
3/16/94 Patentblatt 94/11

(84) Designated contracting states:
AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL PT SE

(71) Applicant: Ihde, Dr. Stefan
Klaus Alfred
Lindenstrasse 68
CH-8738 Uetliburg (CH)

(72) Inventor: Ihde, Dr. Stefan
Klaus Alfred
Lindenstrasse 68
CH-8738 Uetliburg (CH)

(54) Process for Device for Metering and Blending Multicomponent Materials.

(57) The present invention pertains to a process and a device for metering and blending multicomponent materials, especially dental filling materials based on dental cements, alloy and composites as well as their derivatives.

To prepare underfillings, fillings and cementings, which have different compositions, consistency and color, individually and rapidly by blending [German original incorrect - Tr.Ed.], a solution is proposed, which guarantees individual metering and intense blending of the material components, on the one hand, and, on the other hand, utilizes the advantages of a capsule blending and application system. The blend-specific data given on the code cards are fed into a computer for process control in a metering and blending device; the maximum allowable deviations from set limit values and the optimal blending time and blending force are determined on the basis of the preset values; the data thus obtained are converted into control signals and used to fill a single-chamber blending capsule with the corresponding powdered and liquid material components from filled dispensers and for intensely blending the components after introducing the filled and closed blending capsule into a vibratory blender.

Figure 1

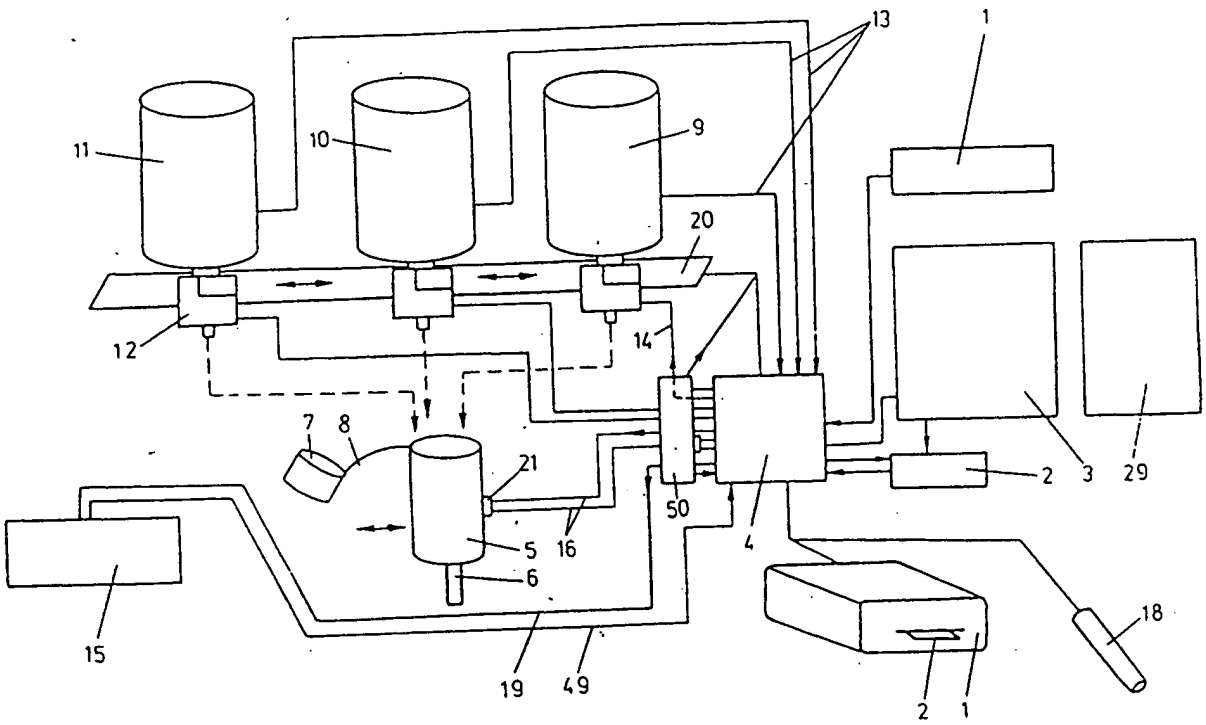

Fig.1

European Patent Office

EUROPEAN SEARCH REPORT

Application No.: EP 93 11 4256

DOCUMENTS CONSIDERED AS PERTINENT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Affected claim	Classification of the Application (Int. Cl.[5])
A	EP-A-0 104 116 (MICROTEC) * Page 7, line 7 - page 9, line 20; Figures 1, 8 *	1, 3, 11	A61C5/06 B01F13/00
D,A	DE-A-31 02 611 (LIEBHERR) 8 Abstract; Figure 1 *	1, 11	
A	DE-A-37 32 042 (ZUBLER) * Claim 1; Figure 1 *	1, 11	
D,A	DE-A-29 44 869 (ITALTINTO) * Claim 1; Figure 4 *	1, 11	
A	US-A-4 648 532 (GREEN) * Abstract; Figures 1-3 *	19-21	

Technical areas searched (Int. Cl.[5])

A61C
B01F

The present Search Report was prepared with respect to all claims.

Place of the search	Date of completion of search	Examiner
THE HAGUE	July 14, 1994	Kousouretas, I.

CATEGORY OF THE DOCUMENTS CITED

X: Particularly pertinent in itself

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